

15 Rathbun Lake

15.1 General Background

Rathbun Lake was impounded in 1969 and reached multipurpose pool level on 10 October 1970. The main threats to water quality of Rathbun Lake are nutrients, sediment, bluegreen algae, bacterial contamination, and herbicides / pesticides. Rathbun Lake inflows are listed on Iowa's 303(d) impaired waters list due to low dissolved oxygen and nutrients. To address watershed landuse - water quality issues, the Rathbun Land and Water Alliance (RLWA, www.rlwa.org) was formed. Members include the Rathbun Rural Water Association, Soil and Water Conservation Districts and County Governments within the Rathbun Lake watershed. Partners include the Iowa Farm Bureau, Iowa Department of Natural Resources, Iowa Dept of Agriculture, Iowa State University, NRCS, FSA, and the Corps of Engineers. The mission of the Alliance is to 'foster a voluntary approach driven by landowners, water users, and public and private organizations to protect and enhance land, water, and economic resources in the Rathbun region'.

15.1.1 Location

Rathbun Lake is located approximately 120 km (75 miles) southeast of Des Moines in south central Iowa. The dam is located on the Chariton River at river kilometer 227 (river mile 142). The watershed is located in Appanoose, Wayne, and Lucas Counties. Historic water quality sites at Rathbun Lake include 4 lake, 1 outflow, and 15 inflow (Figure 15.1).

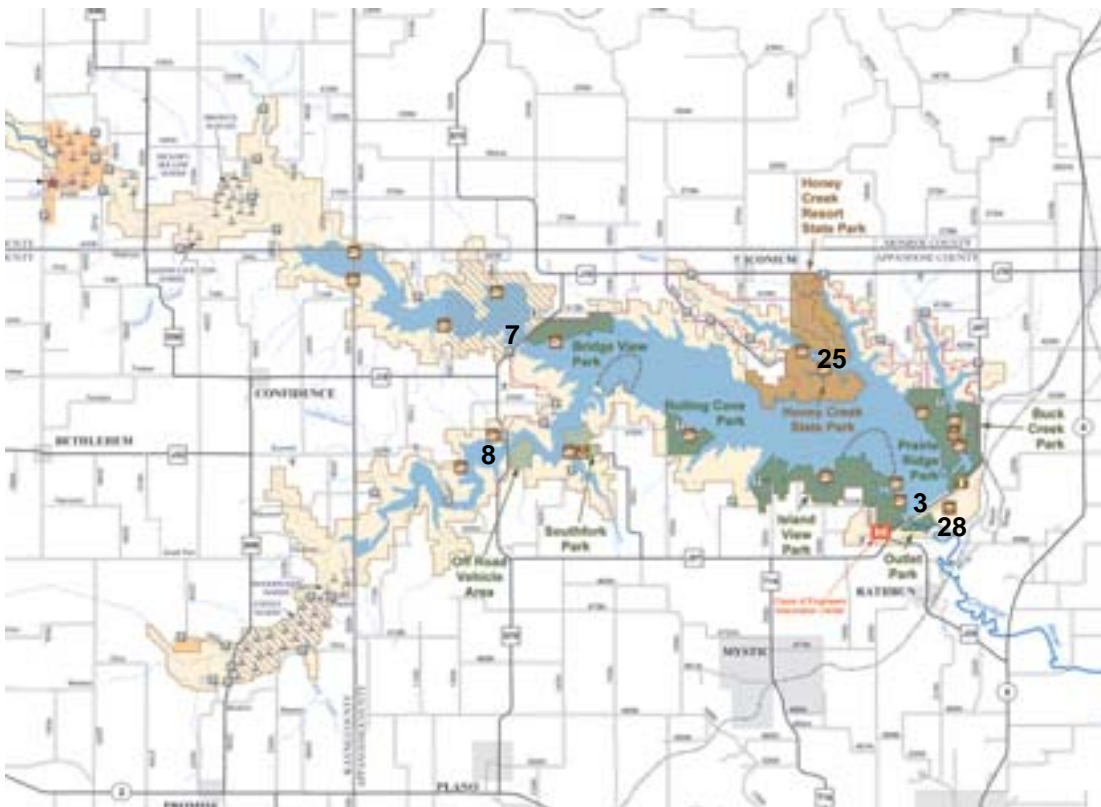


Figure 15.1. Rathbun Lake area map with sample site locations.

15.1.2 Authorized Purposes: Flood damage reduction, water supply, water quality improvement, recreation, and fish and wildlife management.

15.1.3 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	926.0	345.5	21,000	155
Multipurpose	904.0	190.7	11,000	
Total		536.2		

Total watershed area: 549 sq miles (351,360 A)

Watershed ratio: 16.73 FC / 31.94 MP

Average Annual Inflow: 355,704 acre-feet

Average Annual outflow: 000 acre-feet

Average flushing rate:

Sediment inflow (estimated): 240 AF/yr

15.2 2005 Activities

Rathbun Lake was categorized as an 'ambient' lake during 2005, thus only surface samples were collected at the four lake sites. Sample collections occurred from May through September, with vertical profiles recorded at all four sites during each trip. Rathbun Lake staff (OF-RA) providing field sampling assistance during 2005 included Paul Egeland. Bill Duey, OF-RA Operations Manager, provided insight and background regarding Rathbun Lake. Data has been shared with the Rathbun Land and Water Alliance, Iowa State University, and Iowa Dept of Natural Resources. In addition, two RLWA meetings were attended.

15.3 2005 Data

Comparative historic water quality data consists of monthly (April – September) samples collected from 1997 through 2005.

15.3.1 Inflow

Inflow samples were collected by Iowa State University (Dr John Downing) and analyzed by both the Iowa State University Limnology Lab as well as our lab in Omaha. Historically, sediment, nutrient, and herbicide contaminants have been of major concern related to inflows into Rathbun Lake.

15.3.2 Lake

Total nitrogen (TN) median concentrations and chlorophyll a values indicate Rathbun Lake is eutrophic. Monthly and annual variability in total nitrogen is evident at all sites

(see Figure 15.2 for Site 8 as an example). Median concentrations range from 1.0 – 1.4 mg/L TN (Figure 15.3), which exceeds EPA's proposed ecoregional nutrient criteria value of 0.36 mg/L TN. The measured values are typical for district lakes.

Median total phosphorus concentrations ranged from 0.05 – 0.1 mg/L for surface samples collected between 1997 and 2005 at Rathbun Lake (Figure 15.4). Although these values would indicate mesotrophic waters, they do exceed EPA's proposed ecoregional nutrient criteria value of 0.02 mg/L. Median TP concentrations are typical for district lakes.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a waterbody. Ratios $\geq 20:1$ are indicative of desirable algal communities, whereas ratios $\leq 12:1$ are indicative of bloom-forming cyanobacteria (blue green algae). As would be expected, there is high monthly and annual variability in the TN:TP ratio at all sites; see Figure 15.5 as an example at Site 3. Median TN:TP ratios were < 12 at both upper lake sites (Sites 7 and 8) but slightly higher at lower lake sites (Figure 15.6). These values indicate the lake is at risk for cyanobacteria blooms. Microcystin toxins were detected at Rathbun Lake during 2000 and 2001 (Dr. Jennifer Graham, USGS, personal communication).

Rathbun Lake exhibited longitudinal differences in chlorophyll *a* concentrations by site from uplake to lower lake (Figure 15.7), which would be expected due to sediment and nutrient inflows. Median values indicate Rathbun Lake is eutrophic. Secchi depth measurements provided a completely opposite longitudinal gradient as chlorophyll (Figure 15.8). Significantly higher water clarity (0.76 m) was measured at Site 3 (Tower) and Site 25 (Honey Creek arm), whereas very limited clarity (0.26 – 0.4 m) was measured at both Site 7 (Chariton River arm) and Site 8 (South Fork Chariton River arm).

Between 1997 and 2005, median atrazine concentrations (1.0 – 1.5 ug/L) were less than EPA's drinking water maximum contaminant level (MCL) of 3 ug/L (Figure 15.9). However, individual samples measured from surface samples during this period were significant enough to exceed the MCL. Figure 15.10 depicts sample concentrations measured by sample date at Site 8 (South Fork Chariton River) between 1997 and 2005.

Cyanazine exceeded EPA's drinking water maximum contaminant level (1 ug/L) at all sites during 1997 and up lake sites during 1998. No value has exceeded 1 ug/L at any site since 1998.

Total iron exceeded EPA's Drinking Water Standard of Secondary Maximum Contaminant Levels (SMCL) of 300 ug/L from surface samples collected during August 2005 at both upper lake sites. Site 7 was approximately 1.5x higher (498 ug/L) than the SMCL, whereas Site 8 exceeded the SMCL by a factor of 5 (1479 ug/L). Implications are directed at drinking water facilities related to taste and staining issues. In addition, surface samples collected from Sites 3, 7 and 8 during August 2005 exceeded EPA's SMCL for manganese (50 ug/L). Sample concentrations ranged from 55 – 415 ug/L, with highest concentrations measured at up lake sites. Implications are directed at drinking water facilities due to taste and stain issues.

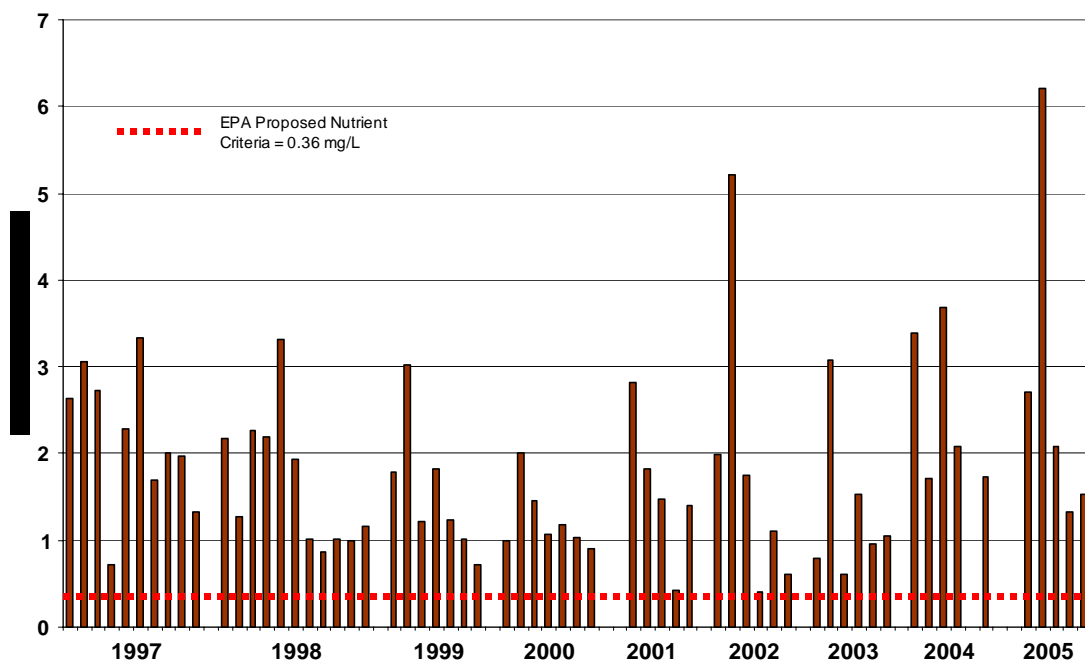


Figure 15.2 Total nitrogen concentrations by sample date collected from surface water samples at Site 8 (Southfork of Chariton River arm) in Rathbun Lake from 1997 through 2005.

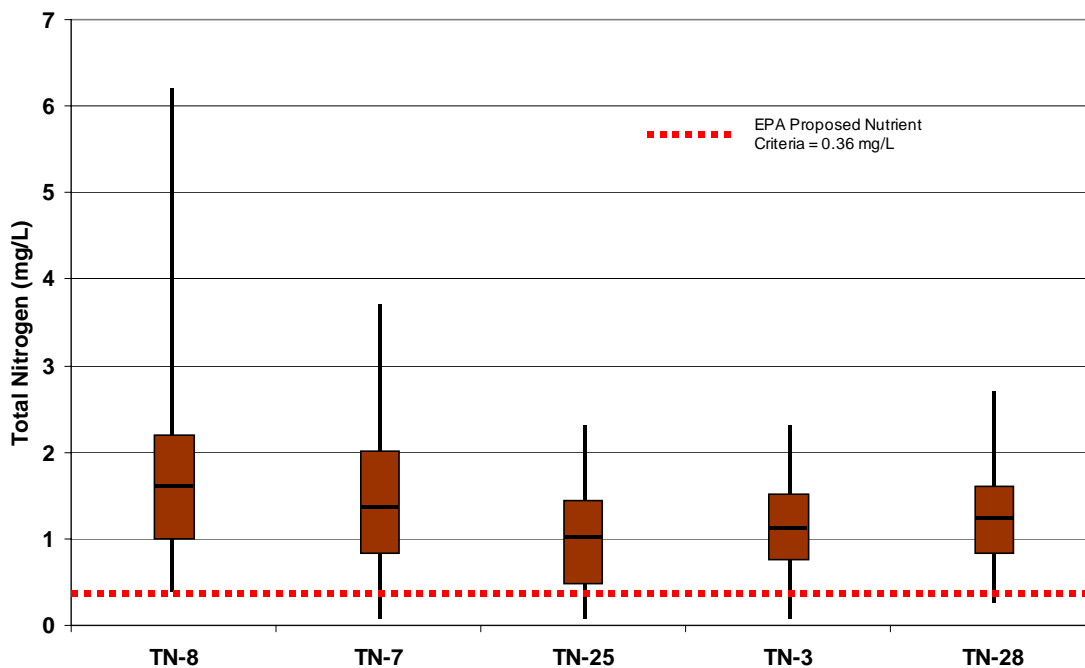


Figure 15.3. Box plots of surface water sample total nitrogen concentrations measured by site from 1997 through 2005 at Rathbun Lake.

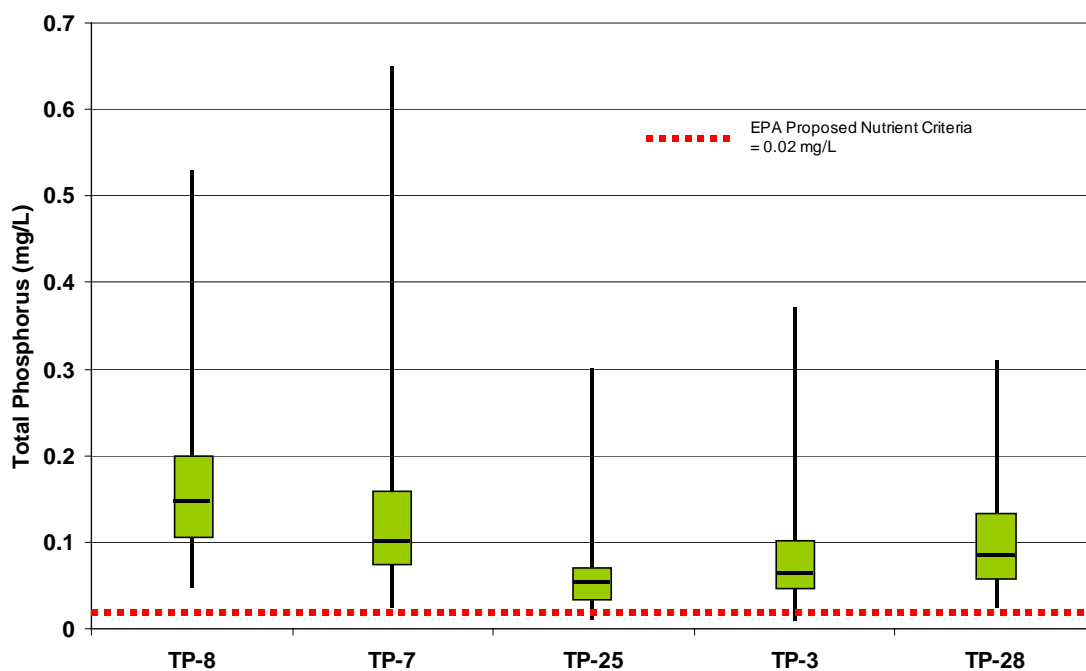


Figure 15.4. Box plots of surface water sample total phosphorus concentrations measured by site from 1997 through 2005 at Rathbun Lake.

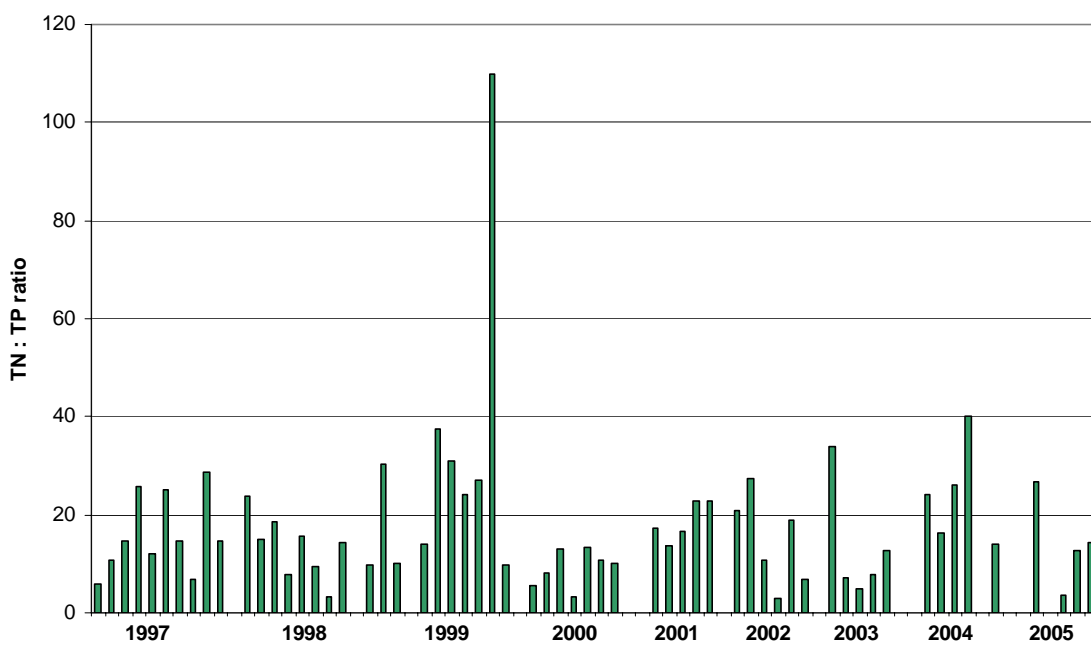


Figure 15.5. Graph of total nitrogen : total phosphorus ratio (TN : TP) by sample date from 1997 through 2005 at Site 3 (Tower) in Rathbun Lake.

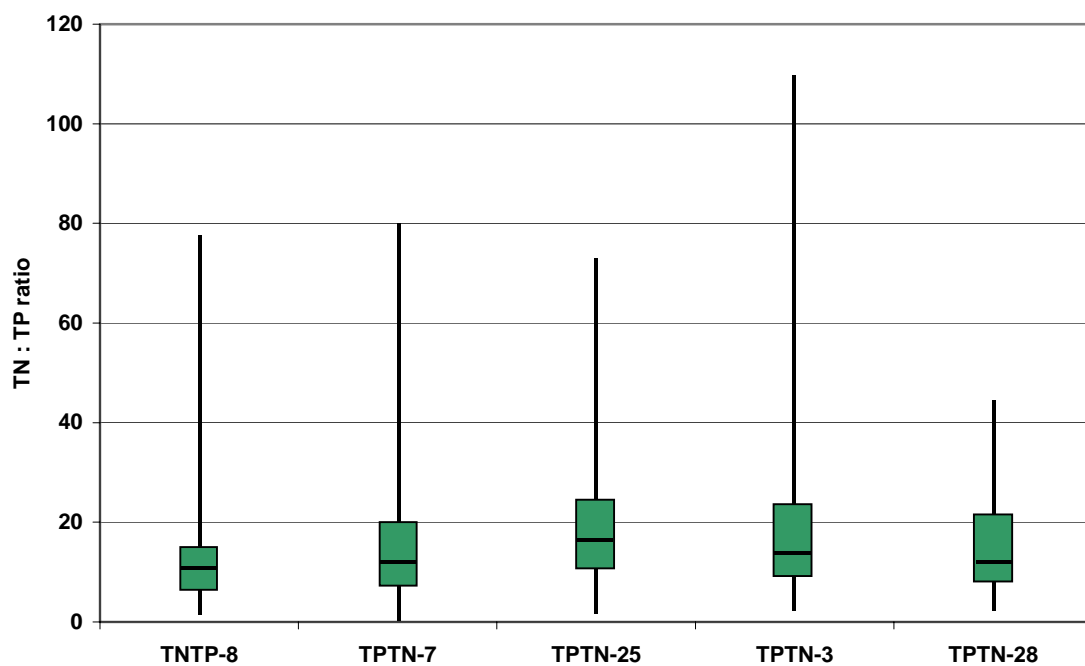


Figure 15.6. Box plots of total nitrogen : total phosphorus (TN : TP) ratio by site from 1997 through 2005 at Rathbun Lake.

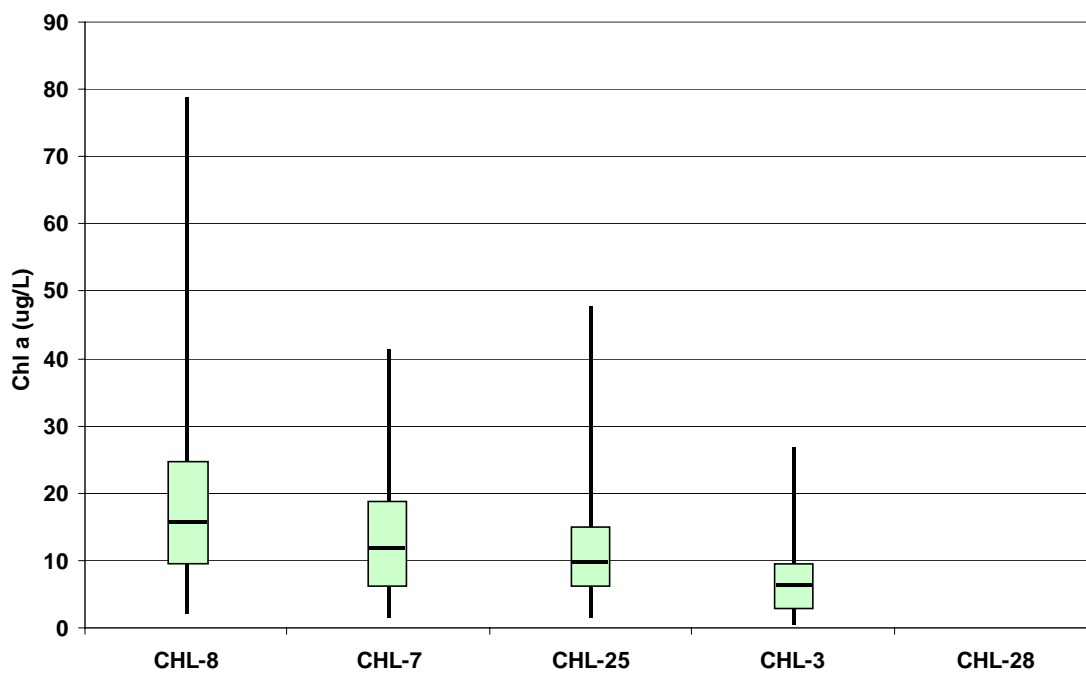


Figure 15.7. Box plots of chlorophyll a concentration measurements by site from 1997 through 2005 at Rathbun Lake.

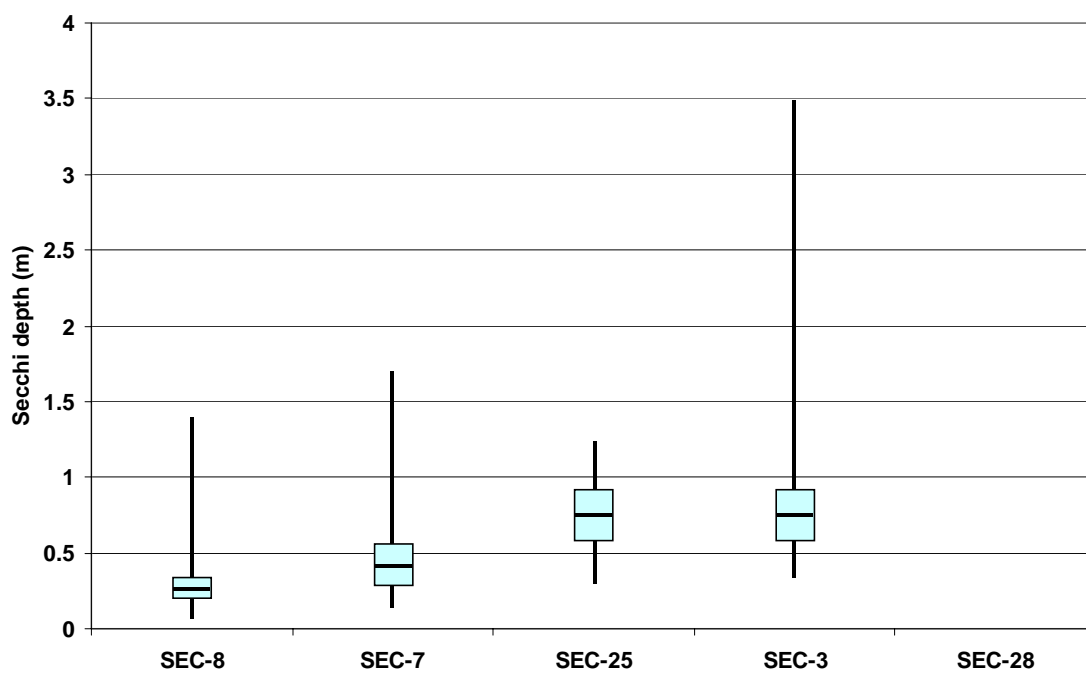


Figure 15.8. Box plot of secchi depth by site from 1997 through 2005 at Rathbun Lake.

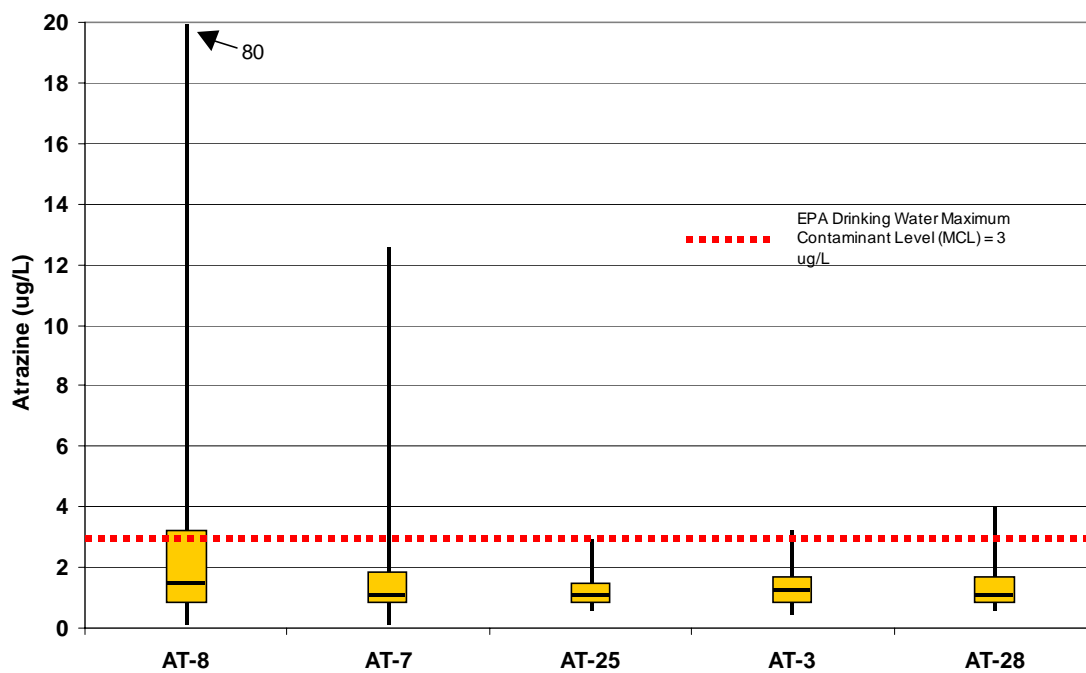


Figure 15.9. Box plots of atrazine concentrations from surface samples

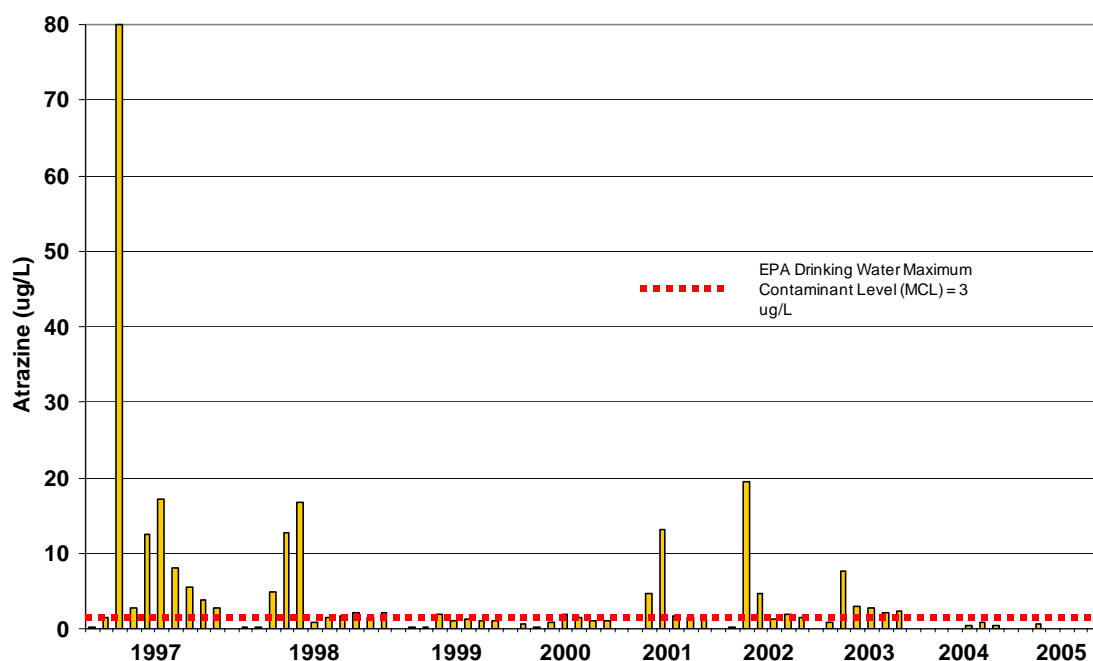


Figure 15.10 Atrazine concentrations from surface water samples by sample date at Site 8 (South Fork Chariton River arm) in Rathbun Lake from 1997 through 2005.

Vertical profiles were recorded during sample trips in June, July and September 2005. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on these profiles, the lake was weakly stratified chemically during June (Figure 14.9). Lake stratification was more pronounced both thermally and chemically between a depth of 5 – 7 m during July and August, while destratification was occurring during the September sampling trip.

15.3.3 Outflow

No outflow samples were collected from Rathbun Lake during 2005.

15.4 Future Activities and Recommendations

Continue to cooperate with Iowa State University, Iowa DNR, and Rathbun Land and Water Alliance to monitor water quality parameters relative to BMP improvement programs within the watershed. Iowa State University will continue to collect inflow samples from 15 sites within the Rathbun Lake watershed. Inflows will be sampled 2x / month from March through June to target the 'wet' period, will transition to 1x / mo sampling from July through November, and no sampling will occur during the winter months (December – February). Sampling activities for 2006 will include transition to monthly 'intensive' monitoring from April through September, as well as conducting monthly vertical profiles at each of the four lake sites.

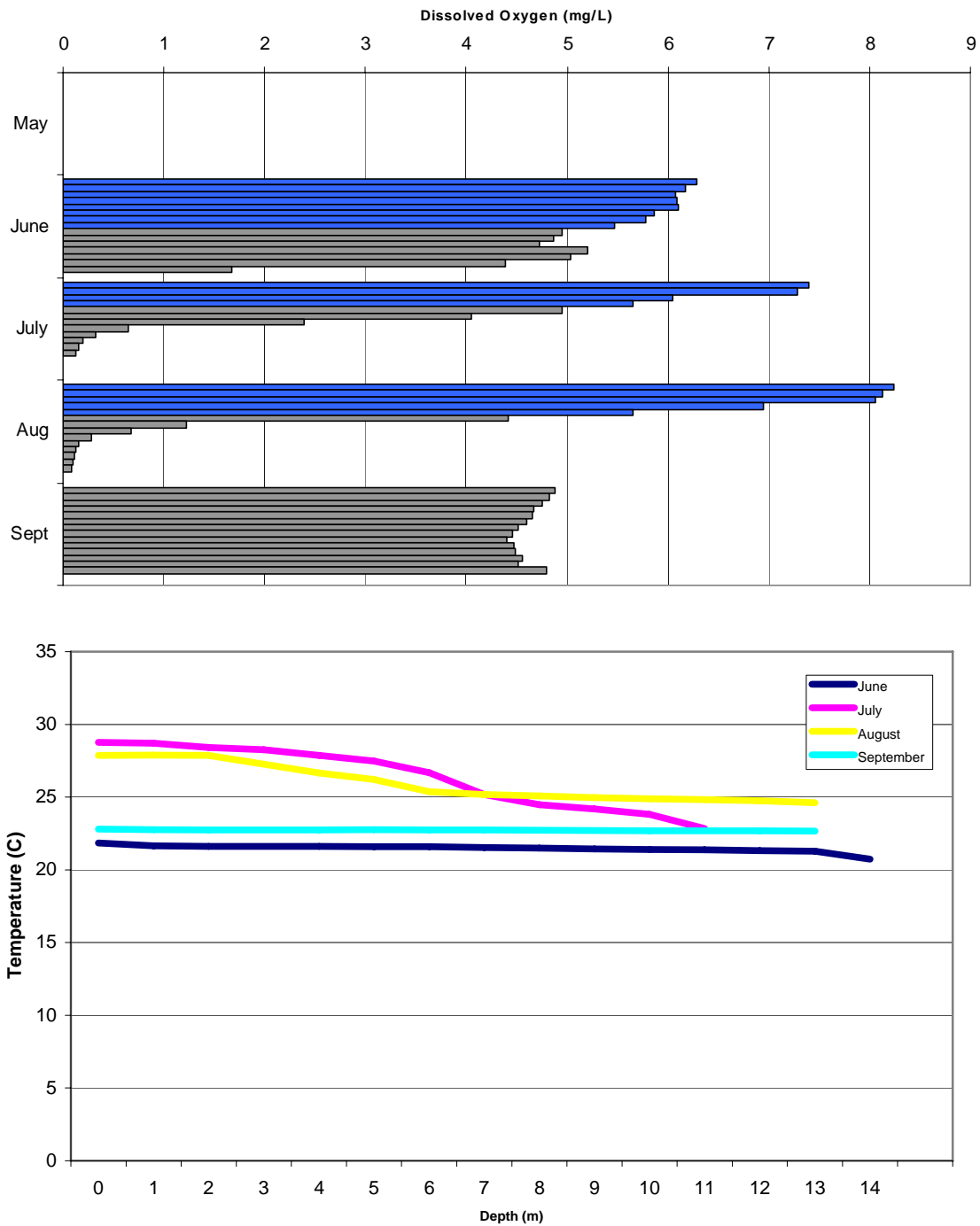


Figure 15.11. Dissolved oxygen concentration (mg/L) histogram and temperature (°C) plot from vertical profiles recorded at Site 3 (Tower) from June through September 2005.